440.01 General

Full design level is the highest level of design and is used on new and reconstructed highways. These projects are designed to provide optimum mobility, safety, and efficiency of traffic movement. The overall objective is to move the greatest number of vehicles, at the highest allowable speed, and at optimum safety. Major design controls are functional classification, terrain classification, urban or rural surroundings, traffic volume, traffic character and composition, design speed, and access control.

440.02 References

Revised Code of Washington (RCW) 46.61.575, Additional parking regulations

RCW 47.05.021, Functional classification of highways.

RCW 47.24, City Streets as Part of State Highways

Washington Administrative Code (WAC) 468-18-040, "Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings"

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), M 41-10, WSDOT.

Plans Preparation Manual, WSDOT, M 22-31

Local Agency Guidelines (LAG), M 36-63, WSDOT

A Policy on Geometric Design of Highways and Streets (Green Book), 2001, AASHTO

A Policy on Design Standards - Interstate System, 1991, AASHTO

440.03 Definitions

auxiliary lane The portion of the roadway adjoining the through lanes for parking, speed change, turning, storage for turning, weaving, truck climbing, and other purposes supplementary to through-traffic movement.

bikeway Any trail, path, part of a highway or shoulder, sidewalk, or any other traveled way specifically signed and/or marked for bicycle travel.

collector system Routes that primarily serve the more important intercounty, intracounty, and intraurban travel corridors, collect traffic from the system of local access roads and convey it to the arterial system, and on which, regardless of traffic volume, the predominant travel distances are shorter than on arterial routes (RCW 47.05.021).

design speed The speed used to determine the various geometric design features of the roadway.

divided multilane A roadway with 2 or more through lanes in each direction and a median that physically or legally prohibits left-turns, except at designated locations.

freeway A divided highway that has a minimum of two lanes in each direction, for the exclusive use of traffic, and with full control of access.

frontage road An auxiliary road that is a local road or street located on the side of a highway for service to abutting property and adjacent areas and for control of access.

functional classification The grouping of streets and highways according to the character of the service they are intended to provide.

high pavement type Portland cement concrete pavement or hot mix asphalt pavement on treated base.

incorporated city or town A city or town operating under either Title 35 or 35A RCW.

intermediate pavement type Hot Mix asphalt pavement on an untreated base.

Interstate System A network of routes selected by the state and the FHWA under terms of the federal aid acts as being the most important to the development of a national system. The Interstate System is part of the principal arterial system.

lane A strip of roadway used for a single line of vehicles.

lane width The lateral design width for a single lane, striped as shown in the Standard Plans and Standard Specifications. The width of an existing lane is measured from the edge of traveled way to the center of the lane line or between the centers of adjacent lane lines.

limited access highway All highways where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

low pavement type Bituminous surface treatment (BST).

managed access highway All highways where the rights of direct access to or from abutting lands have not been acquired from the abutting landowners.

median The portion of a highway separating the traveled ways for traffic in opposite directions.

minor arterial system A rural network of arterial routes linking cities and other activity centers that generate long distance travel and, with appropriate extensions into and through urban areas, form an integrated network providing interstate and interregional service (RCW 47.05.021).

National Highway System **(NHS)** An interconnected system of principal arterial routes that serves interstate and interregional travel; meets national defense requirements; and serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities, and other major travel destinations. The Interstate System is a part of the NHS.

operating speed The speed at which drivers are observed operating their vehicles during free-flow conditions. The 85th percentile of the distribution of observed speeds is most frequently used.

outer separation The area between the outside edge of traveled way for through traffic and the nearest edge of traveled way of a frontage road or C-D road.

posted speed The maximum legal speed as posted on a section of highway using regulatory signs.

principal arterial system A connected network of rural arterial routes with appropriate extensions into and through urban areas, including all routes designated as part of the Interstate System, that serve corridor movements having travel characteristics indicative of substantial statewide and interstate travel (RCW 47.05.021).

roadway The portion of a highway, including shoulders, for vehicular use.

rural area An area that meets none of the conditions to be an urban area.

shoulder The portion of the roadway contiguous with the traveled way, primarily for accommodation of stopped vehicles, emergency use, lateral support of the traveled way, and use by pedestrians and bicycles.

shoulder width The lateral width of the shoulder, measured from the edge of traveled way to the edge of the roadway or face of curb.

suburban area A term for the area at the boundary of an urban area. Suburban settings may combine higher speeds common in rural areas with activities that are more similar to urban settings. Separate design values are not given for suburban areas, classify suburban areas as either urban or rural as best fits the existing or design year conditions.

traveled way The portion of the roadway intended for the movement of vehicles, exclusive of shoulders and lanes for parking, turning, and storage for turning.

two-way left-turn lanes (TWLTL) A lane, located between opposing lanes of traffic, to be used by vehicles making left turns from either direction, either from or onto the roadway.

undivided multilane A roadway with 2 or more through lanes in each direction on which left-turns are not controlled.

urban area An area defined by one or more of the following:

- An area including and adjacent to a municipality or other urban place having a population of five thousand or more, as determined by the latest available published official Federal census, decennial or special, within boundaries to be fixed by a State highway department, subject to the approval of the FHWA.
- Within the limits of an incorporated city or town
- Characterized by intensive use of the land for the location of structures and receiving such urban services as sewer, water, and other public utilities and services normally associated with an incorporated city or town.
- With not more than twenty-five percent undeveloped land.

urbanized area An urban area with a population of 50,000 or more.

usable shoulder The width of the shoulder that can be used by a vehicle for stopping.

440.04 Functional Classification

As provided in RCW 47.05.021, the state highway system is divided and classified according to the character and volume of traffic carried by the routes and distinguished by specific geometric design criteria. The functional classifications used on highways, from highest to lowest classification, are Interstate, principal arterial, minor arterial, and collector. The higher functional classes give more priority to through traffic and less to local access.

The criteria used to determine the functional classification consider the following:

- Urban population centers inside and outside the state stratified and ranked according to size.
- Important traffic generating economic activities, including but not limited to recreation, agriculture, government, business, and industry.
- Feasibility of the route, including availability of alternate routes inside and outside the state.
- Directness of travel and distance between points of economic importance.
- Length of trips.
- Character and volume of traffic.
- Preferential consideration for multiple service which shall include public transportation.
- Reasonable spacing depending upon population density.
- System continuity.

440.05 Terrain Classification

To provide a general basis of reference between terrain and geometric design, three classifications of terrain have been established.

Level. Level to moderately rolling. This terrain offers few or no obstacles to the construction of a highway having continuously unrestricted horizontal and vertical alignment.

Rolling. Hills and foothills. Slopes rise and fall gently but occasional steep slopes might offer some restriction to horizontal and vertical alignment.

Mountainous. Rugged foothills, high steep drainage divides, and mountain ranges.

Terrain classification pertains to the general character of the specific route corridor. Roads in valleys or passes of mountainous areas might have all the characteristics of roads traversing level or rolling terrain and are usually classified as level or rolling rather than mountainous.

440.06 Geometric Design Data

(1) State Highway System

For projects designed to full design level, all highways in rural areas and limited access highways in urban areas the geometric design data is controlled by the functional class (Figures 440-4 through 7b). The urban managed access highway design class (Figure 440-8) may be used on managed access highways in urban areas, regardless of the functional class.

(2) State Highways as City Streets

When a state highway within an incorporated city or town is a portion of a city street, the design features must be developed in cooperation with the local agency. For facilities on the NHS, use the *Design Manual* criteria as the minimum for the functional class of the route. For facilities not on the NHS, the *Local Agency Guidelines* may be used as the minimum design criteria; however, the use of *Design Manual* criteria is encouraged where feasible. On managed access highways within the limits of incorporated cities and towns, the cities or towns have full responsibility for design elements outside of curb, or outside the paved shoulder where no curb exists, using the *Local Agency Guidelines*.

(3) City Streets and County Roads

Plan and design facilities that cities or counties will be requested to accept as city streets or county roads according to the applicable design criteria shown in:

- WAC 468-18-040.
- *Local Agency Guidelines*.
- The standards of the local agency that will be requested to accept the facility.

440.07 Design Speed

Vertical and horizontal alignment, sight distance, and superelevation will vary appreciably with design speed. Such features as traveled way width, shoulder width, and lateral clearances are usually not affected. See Chapters 620, 630, 642, and 650 for the relationships between design speed, geometric plan elements, geometric profile elements, superelevation, and sight distance.

The choice of a design speed is influenced principally by functional classification, posted speed, operating speed, terrain classification, traffic volumes, accident history, access control, and economic factors. However, a geometric design that adequately allows for future improvement is the major criterion, rather than strictly economics. Categorizing a highway by a terrain classification often results in arbitrary reductions of the design speed when, in fact, the terrain would allow a higher design speed without materially affecting the cost of construction. Savings in vehicle operation and other costs alone might be sufficient to offset the increased cost of right of way and construction.

It is important to consider the geometric conditions of adjacent sections. Maintain a uniform design speed for a significant segment of highway.

For all rural highways and limited access highways in urban areas, the design speed is given for each design class in Figures 440-4 through 7b.

When terrain or existing development limit the ability to achieve the design speed for the functional class, use a corridor analysis to determine the appropriate design speed. The desirable design speed is not less than given in Figure 440-1. Do not select a design speed less than the posted speed.

Route Type	Posted speed	Desirable Design Speed
Freeways	All	10 mph over the posted speed
non-Freeways	45 mph or less	Not less than the posted speed.
	Over 45 mph	5 mph over the posted speed

Desirable Design Speed
Figure 440-1

On urban highways, that have obvious "street-like" characteristics, operationally and physically, the design speed is less critical to the operation of the facility. Closely spaced intersections and other operational constraints usually limit vehicular speeds more than the design speed.

For managed access facilities in urban areas, select a design speed based on Figure 440-1. In cases where the 440-1 design speed does not fit the conditions, use a corridor analysis to select a design speed. Select a design speed not less than the posted speed and logical with respect to topography, operating speed (or anticipated operating speed for new alignment), adjacent land use, design traffic volume, accident history, access control, and the functional classification. Consider both year of construction and design year. Maintain continuity throughout the corridor, with changes at logical points, such as a change in roadside development.

440.08 Traffic Lanes

Lane width and condition have a great influence on safety and comfort. The minimum lane width is based on the highway design class, terrain type, and whether it is in a rural or urban area. Lanes 12 ft wide provide desirable clearance between large vehicles where traffic volumes are high and a high number of large vehicles are expected. The added cost for lanes 12 ft wide is offset, to some extent, by the reduction in shoulder maintenance cost due to the lessening of wheel load concentrations at the edge of the lane.

Highway capacity is also affected by the width of the lanes. With narrow lanes, drivers must operate their vehicles closer (laterally) to each other than they normally desire. To compensate for this, drivers increase the headway, resulting in reduced capacity.

Figures 440-4 through 440-7a give the minimum lane width for the various design classes for use on all rural highways and urban limited access highways. Figure 440-8 gives the minimum lane widths for urban managed access highways.

The roadway on a curve may need to be widened to make the operating conditions comparable to those on tangents. See Chapter 641 for guidance on width requirements on turning roadways.

440.09 Shoulders

The shoulder width is controlled by the functional classification of the roadway, the traffic volume, and the function the shoulder is to serve.

The more important shoulder functions and the associated minimum widths are given in Figure 440-2.

Shoulder function	Minimum Shoulder Width
Stopping out of the traffic lanes	8 ft
Minimum lateral clearance	2 ft (1)
Pedestrian or bicycle use	4 ft (2)
Large vehicle off tracking on curves.	See Chapters 641 & 910
Maintenance operations.	Varies (3)
Law enforcement	8 ft (4)
Bus stops.	See Chapter 1060.
Slow vehicles turnouts and shoulder driving.	See Chapter 1010
Ferry holding	8 ft (5)
For use as a lane during reconstruction of the through lanes.	8 ft
Structural support	2 ft
Improve sight distance in cut sections.	See Chapter 650
Improve capacity.	See Chapter 610

(1) See Chapters 700 and 710.

(2) Minimum usable shoulder width for bicycles. For additional information, see Chapter 1020 for bicycle and Chapter 1025 for pedestrians.

(3) 10 ft usable width to park a maintenance truck out of the through lane; 12 ft for equipment with outriggers to work out of traffic.

(4) See Chapters 1040 and 1050 for additional information.

(5) Minimum usable shoulder width, 10 ft preferred.

Minimum Shoulder Width
Figure 440-2

Contact the region maintenance office to determine the shoulder width for maintenance operations. When shoulder widths wider than called for in Figures 440-4 through 8 are requested, compare the added cost of the wider shoulders to the added benefits to maintenance operations and other benefits that may be derived. When the maintenance office requests a shoulder width different than for the design class, justify the width selected.

Shoulders also:

- Provide space to escape potential accidents or to reduce their severity.
- Provide a sense of openness, contributing to driver ease and freedom from strain.
- Reduce seepage adjacent to the traveled way by discharging storm water farther away.

Minimum shoulder widths for use on all rural highways and urban limited access highways based on functional classification and traffic volume, see Figures 440-4 through 7b. Figure 440-8 gives the minimum shoulder widths for urban managed access highways without curb.

When curbing with a height less than 24 inches, provide the minimum shoulder widths shown in Figure 440-3. (See 440.11 for information on curb.)

Lane Width	Posted Speed			
	>45 mph	≤45 mph	>45 mph	≤45 mph
	On Left		On Right (3)	
12 ft or wider	4 ft	(1)(2)	4 ft	2 ft
11 ft	4 ft	(1)(2)	4 ft	3 ft (4)

Notes:

(1) When mountable curb is used on routes with a posted speed of 35 mph or less, shoulder width is desirable but, with justification, curb may be placed at the edge of traveled way.

(2) 1 ft for curbs with a height of 8 in or less. 2 ft for curbs or barriers with a height between 8 in and 24 in.

(3) When the route has been identified as a local, state, or regional significant bike route, the minimum shoulder width is 4 ft or as indicated in Chapter 1020 for signed bike lanes.

(4) When bikes are not a consideration, may be reduced to 2 ft with justification.

(5) Measured from the edge of traveled way to the face of the curb.

Shoulder Width for Curbed Sections (5)
Figure 440-3

When traffic barrier with a height of 2 ft or greater is used adjacent to the roadway, the minimum shoulder width from the edge of traveled way to the face of the traffic barrier is 4 ft. Additional width for traffic barrier is not normally required on urban managed access highways.

Where there are no sidewalks the minimum shoulder width is 4 ft. Shoulder widths less than 4 ft will require wheelchairs using the roadway to encroach on the through lane. See Chapter 1025 for additional information and requirements on pedestrians and accessible routes.

The usable shoulder width is less than the constructed shoulder width when vertical features (such as traffic barrier or walls) are at the edge of the shoulder. This is because drivers tend to shy away from the vertical feature. See Chapter 710 for the required widening.

Shoulders on the left between 4 ft and 8 ft are undesirable. Shoulders in this width range might appear to a driver to be wide enough to stop out of the through traffic, when it is not. To prevent the problems that can arise from this, when the shoulder width and any added clearance result in a width in this range, consider increasing the width to 8 ft.

Provide a minimum clearance to roadside objects so that the shoulders do not require narrowing. At existing bridge piers and abutments, shoulders less than full width to a minimum of 2 ft may be used with design exception documentation. See Chapter 700 for design clear zone and safety treatment requirements.

For routes identified as local, state, or regional significant bicycle routes, provide a minimum 4 ft shoulder. Maintain system continuity for the bicycle route, regardless of jurisdiction and functional class. See Chapter 1020 for additional information on bicycle facilities.

Shoulder widths greater than 10 ft may encourage use as a travel lane. Therefore, use shoulders wider than this only where required to meet one of the listed functions.

440.10 Medians

Medians are either restrictive or nonrestrictive. Restrictive medians limit left-turns, physically or legally, to defined locations. Nonrestrictive medians allow left-turns at any point along the route. Consider restrictive medians on multilane limited access highways and multilane managed access highways when the DHV is over 2000.

The primary functions of a median are to:

- Separate opposing traffic.
- Provide for recovery of out-of-control vehicles.
- Reduce head-on accidents.

- Provide an area for emergency parking.
- Allow space for left turn lanes.
- Minimize headlight glare.
- Allow for future widening.
- Control access.

For maximum efficiency, make medians highly visible both night and day. Medians may be depressed, raised, or flush with the through lanes.

The width of a median is measured from edge of traveled way to edge of traveled way and includes the shoulders. The minimum median width for each design class is given in Figures 440-4 through 440-8. When selecting a median width, consider future needs such as wider left shoulders when widening from four to six lanes.

A two-way left-turn lane (TWLTL) may be used as a nonrestrictive median for an undivided managed access highway. (See Figure 440-8.) The desirable width of a TWLTL is 13 ft with a minimum width of 11 ft. For more information on traffic volume limits for TWLTLs on managed access highways, see Chapter 1435. See Chapter 910 for additional information on TWLTL design.

A common form of restrictive median on managed access highways in urban areas is the raised median. The width of a raised median can be minimized by using a dual-faced cement concrete traffic curb, a precast traffic curb, or an extruded curb. For more information on traffic volume limits for restrictive medians on managed access highways, see Chapter 1435.

At locations where the median will be used to allow vehicles to make a u-turn, consider increasing the width to meet the needs of the vehicles making the u-turn. See Chapter 910 for information on u-turn locations.

When the median is to be landscaped or where rigid objects are to be placed in the median, see Chapter 700 for traffic barrier and clear zone requirements. When the median will include a turn-lane lane, see Chapter 910 for left-turn lane design.

440.11 Curbs

(1) General

Curbs are divided into vertical curbs and sloped curbs. Vertical curbs have a face batter not flatter than 1H:3V. Sloped curbs have a sloping face that is more readily traversed.

Curbs can also be classified as mountable. Mountable curbs are sloped curb with a height of 6 in or less, preferably 4 in or less. When the face slope is steeper than 1H:1V, the height of a mountable curb is limited to 4 in or less.

Where curbing is to be provided, ensure that surface water that collects at the curb will drain and not pond or flow across the roadway.

When an overlay will reduce the height of a vertical curb, evaluate grinding to maintain curb height, or replacing the curb, versus the need to maintain the height of the curb.

Curbs can hamper snow removal operations. The area Maintenance Superintendent's review and approval is required for the use of curbing in areas of heavy snowfall.

For curbs at traffic islands, see Chapter 910.

(2) Curb Usage

Curbing is used for the following purposes:

- control drainage
- delineate the roadway edge
- delineate pedestrian walkways
- delineate islands
- reduce right of way
- assist in access control
- inhibit mid-block left turns

Avoid using curbs if the same objective can be attained with pavement markings.

In general, curbs are not used on facilities with a posted speed greater than 40 mph. The exceptions are for predominantly urban or rapidly developing areas where sidewalks are provided or where traffic movements are to be restricted. Justify the use of curb when the posted speed is greater than 40 mph.

(a) Vertical curbs with a height of 6 in or more are required for:

- inhibiting or at least discouraging vehicles from leaving the roadway.
- walkway and pedestrian refuge separations.
- raised islands on which a traffic signal, or traffic signal hardware, is located.

When an overlay is planned, do not reduce the height of the curb to less than 4 inches.

(b) Consider vertical curbs with a height of 6 in or more:

- to inhibit mid-block left turns.
- for divisional and channelizing islands.
- for landscaped islands.

(c) Provide mountable curbs where a curb is needed but higher vertical curb is not justified.

440.12 Parking

In urban areas and rural communities, land use might require parking along the highway. In general, on-street parking decreases capacity, increases accidents, and impedes traffic flow. Therefore, it is desirable to prohibit parking.

Although design data for parking lanes are included on Figures 440-5a through 8, consider them only in cooperation with the municipality involved. The lane widths given are the minimum for parking, provide wider widths when practical.

Angle parking is not permitted on any state route without approval by WSDOT (RCW 46.61.575). This approval is delegated to the State Traffic Engineer. Angle parking approval is to be requested through the HQ Design Office. Provide an engineering study, approved by the region's Traffic Engineer, with the request that shows the parking will not unduly reduce safety and that the roadway is of sufficient width that the parking will not interfere with the normal movement of traffic.

440.13 Pavement Type

The pavement types given in Figures 440-4 through 7a are the recommended for each design class. Submit Form 223-528, Pavement Type Determination to the HQ Materials Laboratory for a final determination of the pavement type to use. When a roadway is to be widened and the existing pavement will remain, the new pavement type may be the same as the existing without a pavement type determination.

440.14 Structure Width

Provide a clear width between curbs on a structure not less than the approach roadway width (lanes plus shoulders). The structure widths given in Figures 440-4 through 8 are the minimum structure width for each design class.

Additional width for barriers is not normally added to the roadway width on structures. When a structure is in a run of roadside barrier with the added width, consider adding the width on shorter structures to prevent narrowing the roadway.

440.15 Right of Way Width

Right of way width must be sufficient to accommodate all roadway elements and required appurtenances necessary for the current design and known future improvements. To allow for construction and maintenance activities, provide 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut. Chapter 640 and the Standard Plans for slope treatment information.

The right of way widths given in Figures 440-4 through 7b, are desirable minimums for new alignment requiring purchase of new right of way. See Chapter 1410 for additional information and consideration on right of way acquisition.

440.16 Grades

Grades can have a pronounced effect on the operating characteristics of the vehicles negotiating them. Generally, passenger cars can readily negotiate grades as steep as 5% without appreciable loss of speed from that maintained on level highways. Trucks, however, travel at the average speed of passenger cars on the level but display up to a 5% increase in speed on downgrades and a 7% or more decrease in speed on upgrades (depending on length and steepness of the grade as well as weight to horsepower ratio).

The maximum grades for the various functional classes and terrain conditions are shown in Figures 440-4 through 7a. For the effects of these grades on the design of a roadway see Chapters 630 and 1010.

440.17 Documentation

A list of the documents that are to be preserved [in the Design Documentation Package (DDP) or the Project File (PF)] is on the following web site: http://www.wsdot.wa.gov/eesc/design/projectdev/

	Divided Multilane	
Design Class	I-1	
Design Year	(1)	
Access Control (2)	Full	
Separate Cross Traffic		
Highways	All	
Railroads	All	
Design Speed (mph)		
Rural	80 (3)	
Urbanized	70 (4)	
Traffic Lanes		
Number	4 or more divided	
Width (ft)	12	
Median Width (ft)	4 lane	6 lanes or more
Rural —Minimum (5)	40	50
Urban —Minimum	16	22
Shoulder Width (ft)		
Right of Traffic	10 (6)	10 (6)
Left of Traffic	4	10 (6)(7)
Pavement Type (8)	High	
Right of Way (9)		
Rural —Width (ft)	63 from edge of traveled way	
Urban—Width (ft)	As required (10)	
Structures Width (ft) (11)	Full roadway width each direction (12)	

	Design Speed (mph)						
Type of Terrain	50	55	60	65	70	75	80
Level	4	4	3	3	3	3	3
Rolling	5	5	4	4	4	4	4
Mountainous	6	6	6	5	5	5	5

Grades (%) (13)

Interstate Notes:

(1) The design year is 20 years after the year the construction is scheduled to begin.

(2) See Chapter 1430 for access control requirements.

(3) 80 mph is the desirable design speed; with a corridor analysis, the design speed may be reduced to 60 mph in mountainous terrain and 70 mph in rolling terrain. Do not select a design speed that is less than the posted speed.

(4) 70 mph is the desirable design speed, with a corridor analysis the design speed may be reduced to 50 mph. Do not select a design speed that is less than the posted speed.

(5) Independent alignment and grade is desirable in all rural areas and where terrain and development permits in urban areas.

(6) 12 ft shoulders are desirable when the truck DDHV is 250 or greater.

(7) For existing 6-lane roadways, existing 6 ft left shoulders may remain with design exception documentation, when they are not being reconstructed, and no other widening is required.

(8) Submit Form 223-528, Pavement Type Determination.

(9) Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut. See 440.15.

(10) In urban areas, make right of way widths not less than those required for necessary cross section elements.

(11) See Chapter 1120 for minimum vertical clearance.

(12) For median widths 26 ft or less, address bridge(s) in accordance with Chapter 1120.

(13) Grades 1% steeper may be provided in urban areas and mountainous terrain with critical right of way controls.

Geometric Design Data, Interstate

Figure 440-4

Design Class		Divided Multilane				Two-Lane						Undivided Multilane	
		P-1		P-2		P-3		P-4		P-5		P-6 (1)	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year (2)	NHS	Over 1,500		Over 700		Over 201 (3)		61-200 (4)		60 and under		Over 700	
	Non NHS					Over 301		101-300		100 and Under			
Access Control		Full (5)		Partial (5)		(5)		(5)		(5)		(5)	
Separate Cross Traffic													
Highways		All		Where Justified		Where Justified		Where Justified		Where Justified		Where Justified	
Railroads (6)		All		All		All (7)		Where Justified (8)		Where Justified (8)		Where Justified (8)	
Design Speed (mph) (9)		80		70		70	60	70	60	60	60	70	60
Minimum (10)		60 (11)		50 (12)		50	40 (12)	50	40 (12)	40	30 (12)	40	30 (12)
Traffic Lanes													
Number		4 or more divided		4 or 6 divided		2		2		2		4	4 or 6
Width (ft)		12		12		12		12		12		12	11 (13)
Shoulder Width (ft)													
Right of Traffic		10 (14)		10		8		6		4		8	8(17)
Left of Traffic		Variable (15)(16)		Variable (15)(16)									
Median Width (ft)													
4 lane		40 (18)	16	60	16							4	2 (19)
6 or more lanes		48 (18)	22	60	22							4	2 (19)
Parking Lanes Width (ft) — Minimum		None		None		None		None	10	None	10	None	10 (20)
Pavement Type (21)		High				High or intermediate							
Right of Way (22) —Width (ft)		(23)	(24)	(23)	(24)	120	80	120	80	100	80	150	80
Structures Width (ft) (25)		Full roadway width (26)				40		40		32		Full roadway width	
Other Design Considerations-Urban						(27)		(27)		(27)		(27)	

	Rural — Design Speed (mph)									**Urban — Design Speed** (mph)						
Type of Terrain	40	45	50	55	60	65	70	75	80	30	35	40	45	50	55	60 (28)
Level	5	5	4	4	3	3	3	3	3	8	7	7	6	6	5	5
Rolling	6	6	5	5	4	4	4	4	4	9	8	8	7	7	6	6
Mountainous	8	7	7	6	6	5	5	5	5	11	10	10	9	9	8	8

Grades (%) (29)

Geometric Design Data, Principal Arterial

Figure 440-5a

Principal Arterial Notes:

(1) Justify the selection of a P-6 design class on limited access highways.

(2) The design year is 20 years after the year the construction is scheduled to begin.

(3) Where DHV exceeds 700, consider four lanes. When the volume/capacity ratio is equal to or exceeds 0.75, consider the needs for a future four-lane facility. When considering truck climbing lanes on a P-3 design class highway, perform an investigation to determine if a P-2 design class highway is justified.

(4) When considering a multilane highway, perform an investigation to determine if a truck climbing lane or passing lane will satisfy the need. See Chapter 1010.

(5) See Chapters 1430 and 1435 and the Master Plan for Limited Access Highways for access control requirements. Contact the HQ Design Office Access & Hearings Unit for additional information.

(6) Contact the Rail Office of the Public Transportation and Rail Division for input on the needs for the railroad.

(7) All main line and major-spur railroad tracks will be separated. Consider allowing at-grade crossings at minor-spur railroad tracks.

(8) Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the hazard potential. Provide justification for railroad grade separations.

(9) These are the design speeds for level and rolling terrain in rural areas. They are the preferred design speeds for mountainous terrain and urban areas. Higher design speeds may be selected, with justification.

(10) These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

(11) In urbanized areas, with a corridor analysis, 50 mph may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

(12) In urban areas, with a corridor analysis these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

(13) 12 ft lanes are required when the truck DDHV is 150 or greater.

(14) 12 ft shoulders are desirable when the truck DDHV is 250 or greater.

(15) Minimum left shoulder width is to be as follows: four lanes — 4 ft: six or more lanes — 10 ft. Consider 12 ft shoulders on facilities with 6 or more lanes and a truck DDHV of 250 or greater.

(16) For existing 6-lane roadways, existing 6 ft left shoulders may remain with design exception documentation, when they are not being reconstructed, and no other widening is required.

(17) When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

(18) On freeways or expressways requiring less than eight lanes within the 20-year design period, provide sufficient median or lateral clearance and right of way to permit addition of a lane in each direction if required by traffic increase after the 20-year period.

(19) When signing is required in the median of a six-lane section, the minimum width is 6 ft. If barrier is to be installed at a future date, an 8 ft minimum median is required.

(20) Restrict parking when DHV is over 1500.

(21) Submit Form 223-528, Pavement Type Determination.

(22) Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut. See 440.15.

(23) 63 ft from edge of traveled way.

(24) Make right of way widths not less than those required for necessary cross section elements.

(25) See Chapter 1120 for the minimum vertical clearance.

(26) For median widths 26 ft or less, address bridges in accordance with Chapter 1120.

(27) For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements, see Chapter 1025. Curb requirements are in 440.11. Lateral clearances from the face of curb to obstruction are in Chapter 700.

(28) For grades at design speeds greater than 60 mph in urban areas, use rural criteria.

(29) Grades 1% steeper may be used in urban areas and mountainous terrain with critical right of way controls.

Geometric Design Data, Principal Arterial
Figure 440-5b

Design Class	Divided Multilane		Two-Lane						Undivided Multilane	
	M-1		M-2		M-3		M-4		M-5 (1)	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year (2) NHS	Over 700		Over 201 (3)		61-200 (4)		60 and Under		Over 700	
Non NHS			Over 401		201-400		200 and Under			
Access Control	Partial (5)		(5)		(5)		(5)		(5)	
Separate Cross Traffic										
Highways	Where Justified		Where Justified		Where Justified		Where Justified		Where Justified	
Railroads (6)	All		All (7)		Where Justified (8)		Where Justified (8)		Where Justified (8)	
Design Speed (mph) (9)	70		70	60	70	60	60	60	70	60
Minimum (10)(11)	50		50	40	50	40	40	30	40	30
Traffic Lanes										
Number	4 or 6 divided		2		2		2		4	4 or 6
Width (ft)	12		12		12		12		12	11 (12)
Shoulder Width (ft)										
Right of Traffic	10		8		6		4		8	8 (15)
Left of Traffic	Variable (13)(14)									
Median Width (ft)										
4 lane	60	16							4	2 (16)
6 lane	60	22								
Parking Lanes Width (ft) — Minimum	None		None		None	10	None	10	None	10 (17)
Pavement Type (18)	High		As required						High or Intermediate	
Right of Way (19) —Width (ft)	(20)	(21)	120	80	120	80	100	80	150	80
Structures (ft) (22)	Full Roadway Width (23)		40		40		32		Full Roadway Width	
Other Design Considerations-Urban			(24)		(24)		(24)		(24)	

Type of Terrain	Rural — Design Speed (mph)									Urban — Design Speed (mph)						
	40	45	50	55	60	65	70	75	80	30	35	40	45	50	55	60 (25)
Level	5	5	4	4	3	3	3	3	3	8	7	7	6	6	5	5
Rolling	6	6	5	5	4	4	4	4	4	9	8	8	7	7	6	6
Mountainous	8	7	7	6	6	5	5	5	5	11	10	10	9	9	8	8

Grades (%)(26)

Geometric Design Data, Minor Arterial

Figure 440-6a

Minor Arterial Notes:

(1) Justify the selection of an M-5 design class on limited access highways.

(2) The design year is 20 years after the year the construction is scheduled to begin.

(3) Where DHV exceeds 700, consider four lanes. When the volume/capacity ratio is equal to or exceeds 0.75, consider the needs for a future four-lane facility. When considering truck climbing lanes on an M-2 design class highway, perform an investigation to determine if an M-1 design class highway is justified.

(4) When considering a multilane highway, perform an investigation to determine if a truck climbing lane or passing lane will satisfy the need. See Chapter 1010.

(5) See Chapters 1430 and 1435 and the Master Plan for Limited Access Highways for access control requirements. Contact the HQ Design Office Access & Hearings Unit for additional information.

(6) Contact the Rail Office of the Public Transportation and Rail Division for input on the needs for the railroad.

(7) All main line and major-spur railroad tracks will be separated. Consider allowing at-grade crossings at minor-spur railroad tracks.

(8) Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the hazard potential. Provide justification for railroad grade separations.

(9) These are the design speeds for level and rolling terrain in rural areas. They are the preferred design speeds for mountainous terrain and urban areas. Higher design speeds may be selected, with justification.

(10) In urban areas, with a corridor analysis these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

(11) These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

(12) When the truck DDHV is 150 or greater, consider 12 ft lanes.

(13) The minimum left shoulder width is 4 ft for four lanes and 10 ft for six or more lanes.

(14) For existing 6-lane roadways, existing 6 ft left shoulders may remain with design exception documentation, when they are not being reconstructed,and no other widening is required.

(15) When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

(16) When signing is required in the median of a six-lane section, the minimum width is 6 ft. If barrier is to be installed at a future date, an 8 ft minimum median is required.

(17) Restrict parking when DHV is over 1500.

(18) Submit Form 223-528, Pavement Type Determination.

(19) Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut. See 440.15.

(20) 63 ft from edge of traveled way

(21) Make right of way widths not less than those required for necessary cross section elements.

(22) See Chapter 1120 for the minimum vertical clearance.

(23) For median widths 26 ft or less, address bridges in accordance with Chapter 1120.

(24) For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements see Chapter 1025. Curb requirements are in 440.11. Lateral clearances from the face of curb to obstruction are in Chapter 700.

(25) For grades at design speeds greater than 60 mph in urban areas, use rural criteria.

(26) Grades 1% steeper may be used in urban areas and mountainous terrain with critical right of way controls.

Geometric Design Data, Minor Arterial
Figure 440-6b

Design Class	Undivided Multilane		Two-Lane					
	C-1		C-2		C-3		C-4	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year (1) NHS	Over 900		Over 301 (2)		201-300 (3)		200 and under	
Non NHS			Over 501		301-500		300 and Under	
Access Control	(4)		(4)		(4)		(4)	
Separate Cross Traffic								
Highways	Where Justified		Where Justified		Where Justified		Where Justified	
Railroads (5)	Where Justified (6)		All (6)		Where Justified (6)		Where Justified (6)	
Design Speed (mph) (7)	70	60	70	60	70	60	60	60
Minimum (8)(9)	40	30	50	40	50	40	40	30
Traffic Lanes								
Number	4	4 or 6	2		2		2	
Width (ft)	12	11 (10)	12		12		12	
Shoulder Width (ft)	8	8 (11)	8		6		4	
Median Width — Minimum (ft)	4	2 (12)						
Parking Lanes Width (ft) — Minimum	None	10	None		None	10	None	10
Pavement Type (13)	High or Intermediate		As required					
Right of Way (ft) (14)	150	80	120	80	120	80	100	80
Structures Width (ft) (15)	Full Roadway Width		40		40		32	
Other Design Considerations — Urban	(16)		(16)		(16)		(16)	

Type of Terrain	Rural — Design Speed (mph)										Urban — Design Speed (mph)								
	25	30	35	40	45	50	55	60	65	70	20	25	30	35	40	45	50	55	60(17)
Level	7	7	7	7	7	6	6	5	5	4	9	9	9	9	9	8	7	7	6
Rolling	10	9	9	8	8	7	7	6	6	5	12	12	11	10	10	9	8	8	7
Mountainous	11	10	10	10	10	9	9	8	8	6	14	13	12	12	12	11	10	10	9

Grades (%) (18)

Geometric Design Data, Collector

Figure 440-7a

Collector Notes:

(1) The design year is 20 years after the year the construction is scheduled to begin.

(2) Where DHV exceeds 900, consider four lanes. When the volume/capacity ratio is equal to or exceeds 0.85, consider the needs for a future four-lane facility. When considering truck climbing lanes on a C-2 design class highway, perform an investigation to determine if a C-1 design class highway is justified.

(3) When considering a multilane highway, perform an investigation to determine if a truck climbing lane or passing lane will satisfy the need. See Chapter 1010.

(4) See Chapters 1430 and 1435 and the Master Plan for Limited Access Highways for access control requirements. Contact the HQ Design Office Access & Hearings Unit for additional information.

(5) Contact the Rail Office of the Public Transportation and Rail Division for input on the needs for the railroad.

(6) Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the hazard potential. Provide justification for railroad grade separations.

(7) These are the design speeds for level and rolling terrain in rural areas. They are the preferred design speeds for mountainous terrain and urban areas. Higher design speeds may be selected, with justification. Do not select a design speed that is less than the posted speed.

(8) In urban areas, with a corridor analysis these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

(9) These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

(10) Consider 12 ft lanes when the truck DHV is 200 or greater.

(11) When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

(12) When signing is required in the median of a six-lane section, the minimum width is 6 ft median. If barrier is to be installed at a future date, an 8 ft minimum median is required.

(13) Submit Form 223-528, Pavement Type Determination.

(14) Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut. See 440.15.

(15) See Chapter 1120 for the minimum vertical clearance.

(16) For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements see Chapter 1025. Curb requirements are in 440.11. Lateral clearances from the face of curb to obstruction are in with Chapter 700.

(17) For grades at design speeds greater than 60 mph in urban areas, use rural criteria.

(18) Grades 1% steeper may be used in urban areas and mountainous terrain with critical right of way controls.

Geometric Design Data, Collector
Figure 440-7b

Design Class	Divided Multilane		Undivided Multilane		Two-Lane	
	$U_{M/A}$-1	$U_{M/A}$-2	$U_{M/A}$-3	$U_{M/A}$-4	$U_{M/A}$-5	$U_{M/A}$-6
DHV in Design Year (1)	Over 700	Over 700	700 – 2,500	Over 700	All	All
Design Speed (mph)	Greater than 45	45 or less	35 to 45	30 or less	Greater than 45	45 or less
Access	(2)	(2)	(2)	(2)	(2)	(2)
Traffic Lanes						
Number	4 or more	4 or more	4 or more	4 or more	2	2
Width (ft) NHS	12 (3)(4)	12 (3)	12 (3)	12 (3)	12 (3)(6)	12 (3)
Non NHS	11 (4)	11 (5)	11 (5)	11 (5)	11 (6)	11 (7)
Shoulder Width (ft)						
Right of Traffic	10	10 (8)	8 (8)	8 (8)	8 (9) (8)	4 (8)
Left of Traffic	4	4 (8)				
Median Width (ft)	10 (10)	3 (10)(11)	(12)	(12)		
Parking Lane Width (ft)	None	10 (13)	10 (13)	8 (14)	10 (15)	8 (14)
Structures Width (ft) (16)	Full roadway width (17)		Full roadway width		32	30
Other Design Considerations	(18)	(18)	(18)	(18)	(18)	(18)

Urban Managed Access Highways Notes:

(1) The design year is 20 years after the year the construction is scheduled to begin.
(2) The urban managed access highway design is only used on managed access highways. See Chapter 1435.
(3) May be reduced to 11 ft with justification.
(4) Provide 12 ft lanes when truck DDHV is 200 or greater.
(5) Consider 12 ft lanes when truck DDHV is 200 or greater.
(6) Provide 12 ft lanes when truck DHV is 100 or greater.
(7) Consider 12 ft lanes when truck DHV is 100 or greater.
(8) See Figure 440-3 when curb section is used.
(9) When DHV is 200 or less, may be reduced to 4 ft.
(10) 12 ft desirable. At left-turn lanes, the minimum median width is 12 ft to accommodate the turn lane.
(11) The minimum median width is 10 ft when median barrier is used.
(12) 2 ft is desirable. When a TWLTL is present 13 ft is desirable, 11 ft is minimum.
(13) Prohibit parking when DHV is over 1500.
(14) 10 ft desirable.
(15) Prohibit parking when DHV is over 500.
(16) See Chapter 1120 for minimum vertical clearance.
(17) See Chapter 1120 for median requirements.
(18) For bicycle requirements, see Chapter 1020. For pedestrian and sidewalk requirements, see Chapter 1025. Lateral clearances from the face of curb to obstruction are in with Chapter 700. For railroad and other roadway grade separation, maximum grade, and pavement type for the functional class, see Figures 440-5a through 7b. Make right of way widths not less than required for necessary cross section elements.

Geometric Design Data, Urban Managed Access Highways
Figure 440-8